Lunar Extravehicular Activity Program

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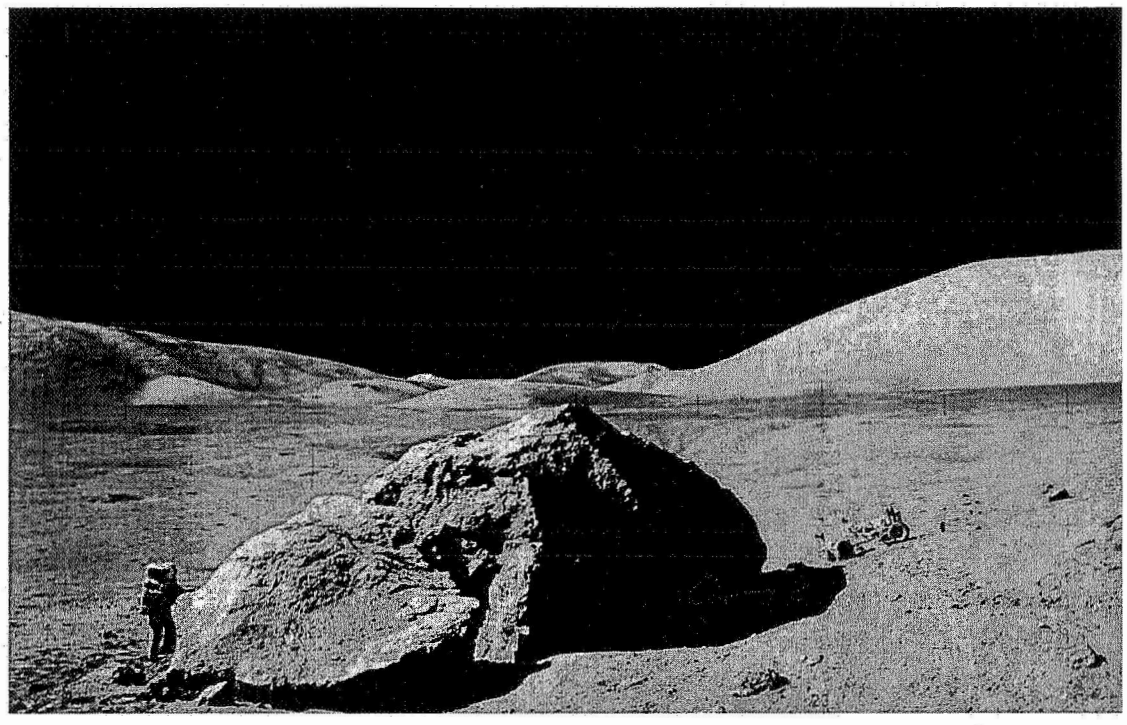

1.0 Introduction

Extravehicular Activity (EVA) has proven an invaluable tool for space exploration since the inception of the space program. There are situations in which the best means to evaluate, observe, explore and potentially troubleshoot space systems are accomplished by direct human intervention. EVA provides this unique capability. There are many aspects of the technology required to enable a "miniature spaceship" to support individuals in a hostile environment in order to accomplish these tasks. This includes not only the space suit assembly itself, but the tools, design interfaces of equipment on which EVA must work and the specific vehicles required to support transfer of humans between habitation areas and the external world.

This lunar mission program will require EVA support in three primary areas. The first of these areas include Orbital stage EVA or micro-gravity EVA which includes both Low Earth Orbit (LEO), transfer and Lunar Orbit EVA. The second area is Lunar Lander EVA capability, which is lunar surface EVA and carries slightly different requirements from micro-gravity EVA. The third and final area is Lunar Habitat based surface EVA, which is the final system supporting a long-term presence on the moon.

2.0 LEO to Lunar Orbit vehicle EVA

LEO to Lunar Orbit vehicle EVA encompasses any direct human intervention required on the vehicle/ module assembly that will transport humans and equipment to lunar orbit.

Groundrules and Assumptions

For the purposes of this section, the following ground rules and assumptions are made[1]:

- An orbiting vehicle/module will remain in lunar orbit to act as "safe haven" and to support logistics transfers to/from the earth and moon (Lunar Orbit Rendezvous concept).
- The orbital vehicle maintains dedicated and independent micro-g EVA capability.
- The Lunar Orbital Module airlock (LOM Airlock) will support independent element launch and docking to the orbital vehicle to protect against launch vehicle uplift mass limitations or relocation to a different docking port after initial LOM assembly launch.
- The airlock will include a remote berthing and capture mechanism, guidance and navigation systems and a discard able booster section.
- Control of berthing ops will take place from the manned orbital vehicle stage
- The orbital vehicle docking port acts as interim airlock until docking of the LOM airlock
- A common suit for both micro-gravity and lunar surface EVA will be used.
- Some separate specialized tools will be required for micro-gravity and surface EVA due to different gravitational environments.

2.1 Lunar Orbital Module/Vehicle Airlock (LOM A/L)

The LOM airlock will support suit checkout, ingress and egress during any planned or contingency LEO or lunar orbit EVAs. It includes a Service and Performance Checkout Assembly (SPCA), which supports umbilical connections for two suits during pre and post EVA stages. The umbilicals provide cooling, communications, and O2 to the crew while connected. The suit sublimator will only function in a vacuum, therefore active cooling via the SPCA umbilical must be used prior to full depress of the airlock and during repress stages. The LOM airlock incorporates two egress hatches providing redundancy in the event of a single hatch failure. It is a single chamber airlock. Hatches between the LOM airlock and the docking port are closed during operations. Closure of the internal docking port hatches to the rest of the lunar orbital vehicle will allow a second isolated volume, which can be used in the event of LOM airlock leaks.

The LOM Airlock exterior will incorporate standard EVA dog-bone cross-section handrails that will be used for crew translation, attachment of specialized restraint tools and temporary stowage devices. The handrails are continuous with no gaps between them in order to support both EVA and Robonaut[2] translation as well as a variety of tethering options. An EVA Tool Stowage Device (ETSD)[3] is located on the exterior of the LOM airlock and contains micro-gravity EVA tools. The ETSD can be removed from the LOM airlock by EVA or Robonaut and be transferred to other locations. ETSD attachment mechanisms or a "footprint" on external logistics carriers will allow tools return to or from earth. The same attachment mechanism on external logistics landers will support transfer between lunar surface and/or earth. The practice of supporting tool stowage externally where at all possible will contribute to the overall lunar dust mitigation plan.